Active Project (2016 - 2016)

Compact Methane Sensing Lidar for Unmanned Aerial Vehicles, Phase I Project

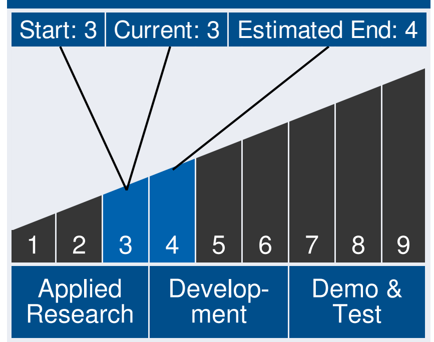
SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

Even though gaseous methane (CH4) is a comparatively sparse constituent in Earth�s atmosphere, it is the third most impactful greenhouse gas after water vapor and carbon dioxide, and the second most important in terms of anthropogenic drivers. Methane is some 60 times more effective than CO2 in absorbing long-wavelength radiation, because the methane absorption lines in that part of the spectrum are less saturated and have less overlap with water vapor lines. Natural and agricultural sources of methane continue to dominate, but are difficult to separate and quantify. World-wide, rice cultivation, biomass burning, ruminant farm animals, and fossil fuel mining and usage have long been the most powerful drivers, but with climate change these sources could be dwarfed in the future by the release of enormous quantities of methane from melting permafrost and/or methane hydrates currently buried deep in ocean sediment. Innovative new remote sensing technologies need to address the atmospheric methane concentration measurement problem for NASA and other applications. Beyond Photonics proposes to investigate specific very compact pulsed lidar designs near the 1.645-micron wavelengths of interest by NASA for atmospheric methane (CH4) and potentially water vapor in the same nominal wavelength region. Specifically, methane concentration from moderate-sized unmanned aerial vehicles of NASA�s choice will be a focus; this application puts particular emphasis on decreasing size, weight, and prime power (SWaP) and eliminating active laser component cooling. Particular emphasis will also be placed on ensuring that the lidar designs are compatible with scaling to space qualification in future such programs. Emphasis will also be placed on technical approaches with good operational flexibility in terms of pulse energy and duration, frequency agility, and application to other IR and SWIR wavelengths.

Table of Contents

Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: Potential NASA applications of the proposed low-SWaP, UAV-borne methane IPDA sensor include identification and quantification of atmospheric methane sources and sinks on a finer spatial scale than currently possible, immediately valuable for climate model improvement and atmospheric sciences. Water vapor concentration can be readily added to such an instrument for further functional enhancement and utility. The single frequency Q-switched Er:YAG lasers developed in this effort will also be applicable to aerosol backscatter measurement and Doppler winds measurement applications. The emphasis on very compact and electrically efficient operation will enhance the potential of such lasers in numerous current and planned NASA missions. IPDA DIAL lidar advancements associated with the proposed work relate directly to transmitter laser, seed laser, transmitted energy monitoring and calibration, and associated photonic component requirements of NASA programs such as CO2 IPDA, ASCENDS, and LAS.

To the commercial space industry:

Potential Non-NASA Commercial Applications: Potential non-NASA commercial applications are of great interest to Beyond Photonics in terms of low cost, compact DIAL product development, as evidenced in our use of company IRAD to further the proposed effort. We ultimately envision commercial development of small, rugged, compact differential absorption lidar (DIAL) sensors for airborne (UAV) methane and CO2 atmospheric constituent detection and characterization. The lasers and lidar technology proposed here will relate to development of compact high-efficiency remote sensing instruments for commercial and military use, including spectroscopy, aerosol backscatter measurements, and wind sensing.

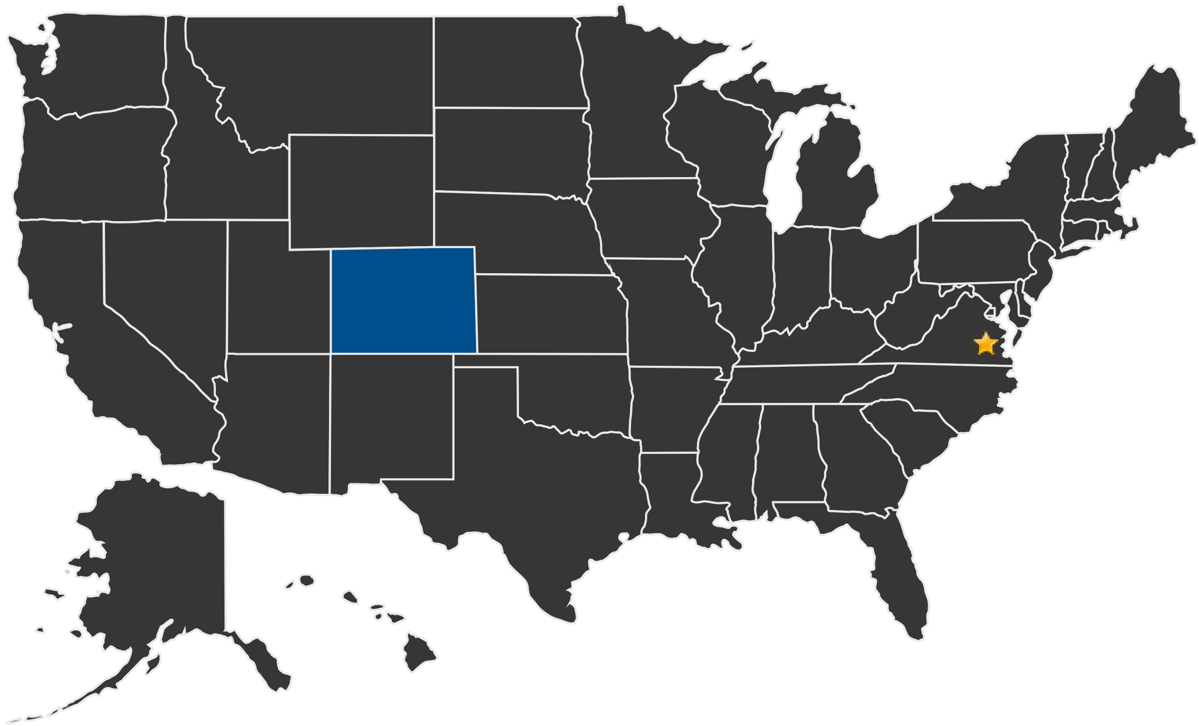
Management Team *(cont.)*

Principal Investigator:
- Sammy Henderson

Technology Areas

Primary Technology Area:
Science Instruments, Observatories, and Sensor Systems (TA 8)
└─ Remote Sensing Instruments and Sensors (TA 8.1)
  └─ Lasers (TA 8.1.5)

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Langley Research Center

Other Organizations Performing Work:

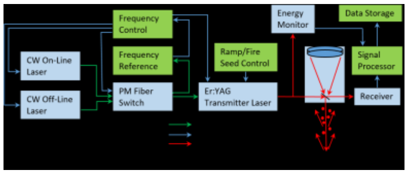
- Beyond Photonics, LLC (Lafayette, CO)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23616)

IMAGE GALLERY



Compact Methane Sensing Lidar for Unmanned Aerial Vehicles, Phase I

DETAILS FOR TECHNOLOGY 1

Technology Title

Compact Methane Sensing Lidar for Unmanned Aerial Vehicles, Phase I

Potential Applications

Potential NASA applications of the proposed low-SWaP, UAV-borne methane IPDA sensor include identification and quantification of atmospheric methane sources and sinks on a finer spatial scale than currently possible, immediately valuable for climate model improvement and atmospheric sciences. Water vapor concentration can be readily added to such an instrument for further functional enhancement and utility. The single frequency Q-switched Er:YAG lasers developed in this effort will also be applicable to aerosol backscatter measurement and Doppler winds measurement applications. The emphasis on very compact and electrically efficient operation will enhance the potential of such lasers in numerous current and planned NASA missions. IPDA DIAL lidar advancements associated with the proposed work relate directly to transmitter laser, seed laser, transmitted energy monitoring and calibration, and associated photonic component requirements of NASA programs such as CO2 IPDA, ASCENDS, and LAS.